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A NEW (OLD) BREED OF PIGS FOR RESEARCH

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CONTENTS

Page
Abstract 1
Introduction 1
Materials and methods 2
Results and discussion 2
Literature cited 6

ILLUSTRATIONS

Fig.
1. Two-year-old American-Essex sow compared with 2-year-old Hormel-Hanford cross sow 3
2. American-Essex piglet at 2 weeks 3
3. American-Essex piglet at 12 weeks 4
4. American-Essex pig at 6 months 4

TABLES

1. Average weight, by age, of the American-Essex pig, two strains of commercial swine, and two miniature strains 5
2. Some biochemical values in the whole-blood and serum components of 27 mature American-Essex pigs 6
3. Hematological values of 27 mature American-Essex pigs 6

A NEW (OLD) BREED OF PIGS FOR RESEARCH

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ABSTRACT

This development, or redevelopment, of a breed of small swine for research was based on a closed colony of apparently Essex-derived pigs, a nearly extinct breed. The pig breeds readily, has a normal gestation length, and farrows easily, but at present has a smaller litter than standard breeds. The young grow slowly. The American-Essex (AE) pig weighs 0.68 kilogram at birth, 5.94 kilograms at weaning, 14.95 kilograms at 20 weeks, 70.1 kilograms at 2 years, and 108.1 kilograms at 4 years. It has normal hematological and biochemical values; it is economical, hardy, docile, and easy to raise and handle. The AE pig seems to have become, through isolation, specific pathogen free (SPF) to a limited extent, ectoparasite free, and troubled only by the ascarid as an internal parasite.
KEYWORDS: American-Essex swine, biochemistry of American-Essex swine, hematology of American-Essex swine, miniature swine, swine, swine for biomedical research.

INTRODUCTION

The use of miniature swine in biomedical research is well established. In 1949, the Hormel Institute in Minnesota began the search for pigs best suited for laboratory investigations. Several varieties of miniature swine have been developed from this Hormel stock, as well as from a Pitman-Moore strain. Other lines have been established from more exotic strains such as the Yucatan, the Vietnamese, the Corsican, and various crossbreeds.

In our research situation, toxicology, we needed a pig of an established breed that would both represent swine rather than man and have the primary advantages of a miniature pig (size and economy). The breed should be docile, easy to handle, and productive. The pigs should breed true. In addition, the breed should be hardy and adaptable to the outdoor climate of Southwest Texas, reflect normal biochemical and physiological values, and have normal swine reactions to toxic substances. These attributes are desirable because of our requirements for blood sampling, biopsies, dietary manipulations, and restraint for measurement of body functions.

Personal knowledge led to a search for a breed of pigs once commonly raised (circa 1940) for food in the ranching areas of southwest Texas. One such herd was found in 1967 in the Hill Country area of Texas. This herd was established in 1916, and except for the introduction of one boar in 1919, it has remained closed on the ranch. The herd ranged freely within the owner's property. Because of the "wolf-proof" fence surrounding the ranch, it is doubtful that other swine could have been introduced. The hogs were lured with corn to pens only periodically (one or two times each year). Docility was remarkable. The pigs were small and black with a russet tinge in the hair, and they appeared to breed true through natural selection. Known locally as Guinea-Essex or Guineas, they conformed to the description, pictures, and personal recollections of experienced individuals at Texas A&M University as being representative of the American-Essex

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(AE) breed of pigs. We first called the pig the Greer-Radeleff (G-R) pig, after the owner and finder of the herd, but later decided on the more generic name of American-Essex (AE).

Our emphasis was, first, on establishing a foundation herd; second, on defining the AE pig in husbandry and in the laboratory; and, finally, on full utilization of the pigs in research. This report concerns the establishment of the herd, its physical characteristics, and some of its biochemical and hematological characteristics.

MATERIALS AND METHODS

Of the four gilts purchased, one was loaned to the College of Veterinary Medicine of Texas A&M University for the start of a specific-pathogen-free (SPF) herd of AE pigs. The second gilt gave birth to three males and one female, and the third, to one boar; the fourth was not pregnant. These, with the return of some of the SPF stock from the College of Veterinary Medicine, were the foundation of our herd.

The pigs were kept in individual 6- by 8-foot pens on smooth concrete slabs with a galvanized wire-mesh fench. Each pen contained either a small wooden shelter (commercial doghouse) or a metal shelter of equivalent size (a two-can garbage storage unit). Water was freely available, and a commercial, nonmedicated feed affording 14 percent crude protein was given twice a day at levels based on the age and weight of the animal. The ration was basically a mixture of sorghum grain and soybean meal containing animal protein products, dehydrated alfalfa leaf meal, processed grain byproducts, and cane molasses, supplemented with vitamins, minerals, and salt. Piglets, up to 4 months old, were given 200 grams of feed twice a day; from 4 to 6 months, 300 grams; from 6 months to 1 year, 400 grams; and over 1 year, 500 grams of feed twice a day.

The sows and gilts were bred twice and checked at the next calculated estrus. They were flushed with bran before farrowing and farrowed in pens with either concrete or wooden floors, using alfalfa bedding and radiant heat for warmth when required. Piglets were examined at birth and weighed, and iodine was applied to the navel. No other medication was given. Sow and piglets were kept in the farrowing houses until weaning at 6 weeks. An 18-percent-protein starter ration was available to the piglets in a creep feeder in the farrowing house. Weights of piglets were recorded on the day of birth and weekly thereafter until weaned. All weaned pigs were individually weighed once a month.

Blood was collected from piglets by heart puncture on a staggered basis. One litter was sampled at birth and at 3 and 6 weeks post partum; other litters were sampled at 2 and 5 weeks post partum; and still others at 1 and 4 weeks post partum. This schedule allowed coverage of the post partum period without endangering the circulatory system of any one piglet. Blood was collected from weaned pigs by venipuncture of the anterior vena cava.

For most hematological determinations, ethylenediaminetetraacetic acid (EDTA) was used as the anticoagulant; sodium citrate was used for coagulation studies. Erythrocyte (RBC) and leukocyte (WBC) counts were determined on a model B Coulter counter. Packed cell volume was done by the microhematocrit method; hemoglobin determinations were made by the HyCel cyanomethemaglobin method. Sedimentation rates were done with a Winthrobe Sed-i-rak. Coagulation studies were done on a BBL automatic fibrometer, using Dade and BBL reagents.

Serum phosphorus, uric acid, urea, creatinine, glucose, and total serum protein were determined with a single-channel Technicon AutoAnalyzer, using the N-clinical methods. Serum calcium, magnesium, potassium, sodium, zinc, copper, and iron were determined as outlined in the Perkin-Elmer manual for the model 403 atomic absorption spectrophotometer. A modified Michel method was used for cholinesterase determinations.

RESULTS AND DISCUSSION

The AE pig is short with a full, square silhouette. The ears are erect, the jowls full, and the face slightly dished. The skin is slate gray to black, and the hair is black with russet overtones. As the animal grows, its back tends to sway and broaden. Dentition in the AE pig is identical to that in other breeds of swine. At 1 to 2 years, the males coarsen in the face, and the body lengthens, with more massive shoul-

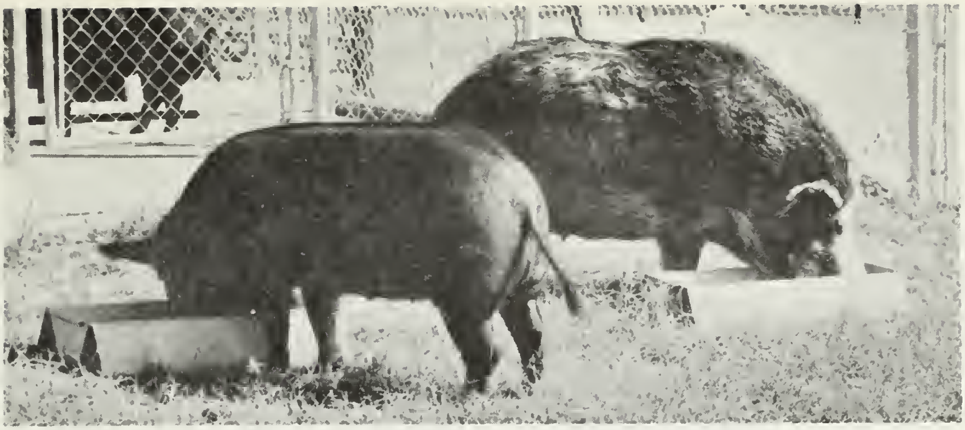

FIGURE 1.—Two-year-old American-Essex sow compared with 2-year-old Hormel-Hanford cross sow. Weights are 64 and 118 kilograms, respectively.

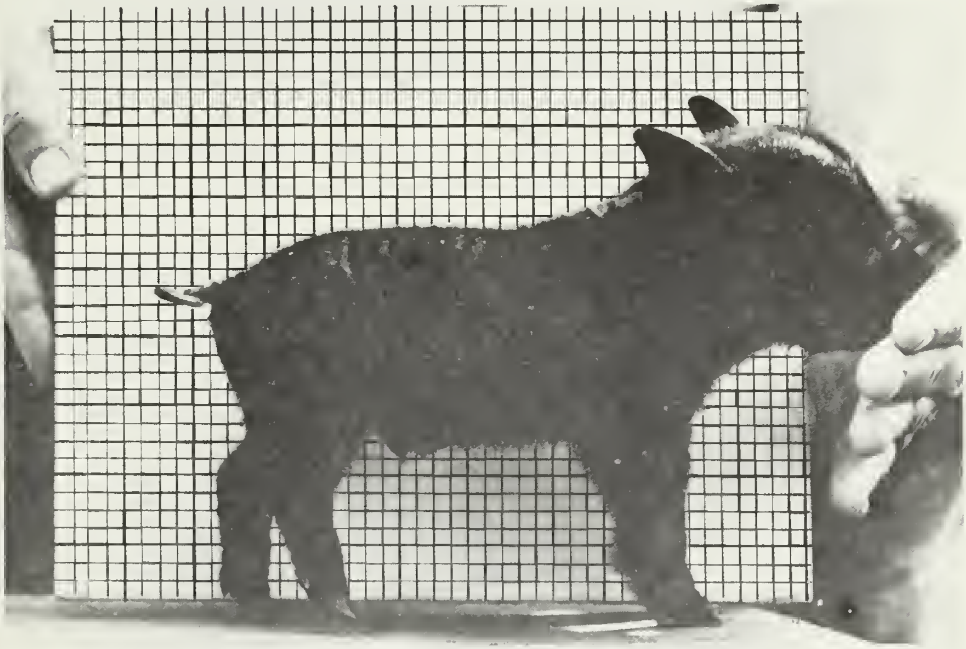

FIGURE 2.—American-Essex piglet at 2 weeks, weight 1.4 kilograms. Background is 8½- by 11-inch graph paper ruled four to the inch.

ders, slimmer flanks, and stronger legs than the females of the same age.

. The AE pig is a hardy breed in this Texas climate. It adapted well to summer daytime temperatures of 85°–102° F with little or no distress. The mild, generally wet winters in the southeastern part of Texas (30°–60° F with lows of 25°–22° F) did not adversely affect them. No cases of influenza or pneumonia have occurred in any of the pigs in over 8 years. We do not immunize the pigs against any disease, but we do maintain strict isolation and high sanitation standards. Regular fecal examinations have shown the occasional presence of ascarid eggs (*Ascaris lumbricoides* var. *suis*), and routine worming with piperazine is done. The pigs have mostly been free of ectoparasites, but the hog louse, *Haematopinus suis,* has been observed, rarely. There have been no infectious or contagious diseases, except for some baby pig scours.

The AE pig is docile. Only the older boars fight, and that tendency can usually be traced to a female in estrus. Baby pigs can be taken off the sow, with the sow showing little nervousness other than grunting. In common with

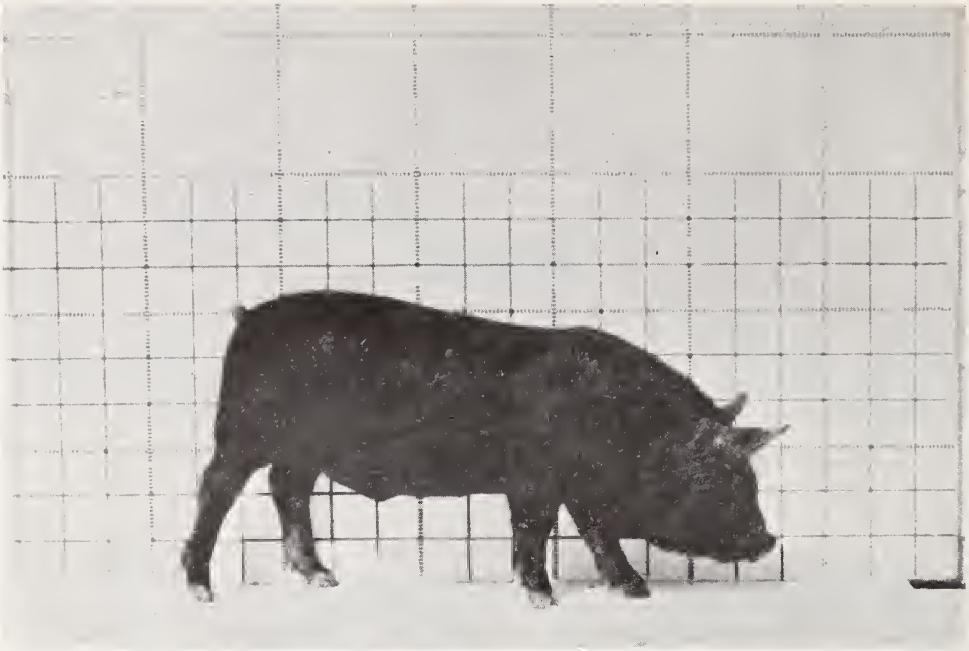

FIGURE 3.—American-Essex piglet at 12 weeks, weight 11.4 kilograms. Small squares are 2 inches; large squares are 6 inches.

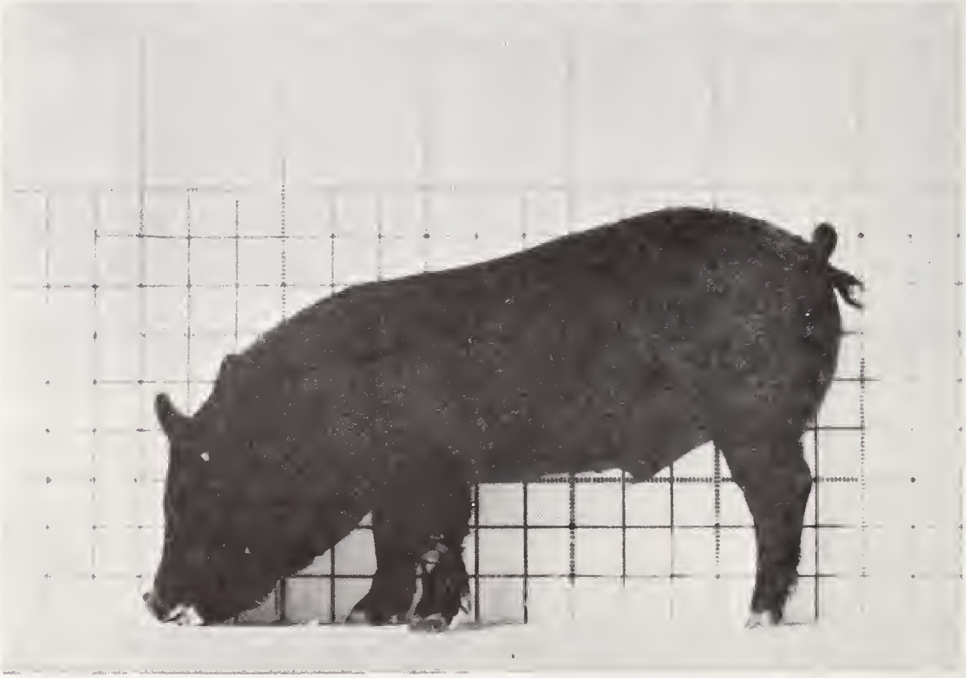

FIGURE 4.—American-Essex pig at 6 months, weight 18.6 kilograms. Small squares are 2 inches; large squares are 6 inches.

other breeds, the AE pig resents restraint, but only vocally, and will relax when put in a breeding trough. Anesthesia is rapid, without excitation. The pig can be easily maintained on inhalation anesthesia after initial preanesthesia and muscle relaxation, with uneventful recovery. Notable, too, was the easy adaptability of these pigs, brought in from the range, to small pens with concrete floors.

Another important aspect of the AE pig is its size. It is not a miniature pig: it is derived, by natural selection in freedom, from the recognized American-Essex. In figure 1, the AE pig is compared to a sow derived from the Hormel-Hanford cross (both sows have had two litters of pigs and are 2 months apart in age). A brood sow from a commercial breed would be twice as large as the Hormel-derived pig. Figures 2–4 show the growth of the AE pig at ages of 2 weeks, 12 weeks, and 6 months. Their weights are, respectively, 1.4, 11.4, and 18.6 kilograms. Commercial hogs are marketed at 5 to 6 months of age at weights of 90 to 100 kilograms (U.S. No. 1, 200 to 220 pounds). Table 1 shows the average weights, by age, of the AE pig compared with two commercial breeds, the Yorkshire (*1*)[2] and the Minnesota No. 1 (*7*), and two of the miniature breeds, the Pitman-Moore (*5*) and the Corsican pig (*6*). Up through 24 months of age, the weight of the AE pig is similar to the weights of the two strains of miniature swine but begins to increase after that, but not at the rate of a commercial pig. Four-year-old commercial brood sows weigh three times as much as AE sows, and the herd sires in a production unit may weigh four times as much as AE boars. The weights of males and females were combined in table 1 to conform to other tables in the literature, but throughout the males weighed more than the females. We have no comparable figures for castrated males. Commercial swine have unrestricted access to food, whereas the miniature pigs are generally restricted in access to food. A group of pigs was fed free choice for comparison, and they gained weight, mainly because of subcutaneous fat deposition. This fat was self-limiting: the females did not conceive on numerous occasions. A limited diet eliminated the excess fat, and

TABLE 1.—*Average weight, by age, of the American-Essex pig, two strains of commercial swine, and two miniature strains* (*male and female weights are combined*)

[Kilograms]

Age		AE[1]	Pitman-Moore[1]	Corsican	Yorkshire[1]	Minnesota No. 1[1]
Birth		0.68 (60)	0.76 (944)	...	1.23 (154)	1.32 (36)
Week ...	3	2.84 (47)	...	...	...	6.0 (21)
	6	5.9 (45)	5.9 (301)	...	...	12.2 (21)
	8	7.4 (45)	...	...	11.8 (127)	16.1 (21)
	10	8.6 (45)	...	...	16.3 (191)	23.4 (21)
	12	9.5 (45)	11.9 (296)	...	20.4 (64)	34.0 (21)
	14	11.1 (44)	...	...	27.2 (142)	45.7 (21)
	16	12.8 (44)	...	10.6	35.8 (85)	54.8 (21)
	18	13.0 (43)	...	...	35.8 (85)	69.9 (21)
	20	14.9 (43)	...	...	47.6 (61)	81.9 (21)
	22	16.9 (43)	...	...	65.2 (220)	...
	24	18.1 (43)	22.0 (324)	26.0	78.8 (80)	...
Month...	12	47.8 (24)	48.0 (329)	40.0	...	...
	18	56.8 (25)	55.0 (320)	...	...	...
	24	70.7 (22)	65.0 (306)	65.5	...	...
	30	98.5 (15)	74.0 (267)	...	...	...
	36	107.1 (15)	78.0 (222)	83.0	...	...
	42	97.3 (6)	82.0 (133)	...	...	...
	48	108.1 (6)	86.0 (101)	...	...	...
	60	113.5 (2)	...	...	...	...

[1] Figures in parentheses are number of animals.

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[2] Italic numbers in parentheses refer to items in "Literature Cited" at the end of this publication.

the females conceived after weight was reduced to a level we considered normal.

It is not known with certainty when the AE pig becomes sexually mature, but the males show sexual interest at 4 months and were successfully mated at 7–8 months. The boars and gilts exhibited normal behavior at mating. The gilts show slight signs of estrus at about 3 months, but we have never bred any under the age of 9 months. Gestation averages 113.5 days. Farrowing is normal, with piglets coming at about 10-minute intervals and the placentas within 2 hours. The sow is not nervous at farrowing.

During the first 4 years, the total number of farrowings was 18, with a total of 76 piglets born, or an average of 4.2 per litter. Additional farrowings within the last year have brought the average litter size up to 6.1 pigs per litter, the difference apparently being a result of rigid selection of boars by an experienced swine husbandman. Average number of piglets weaned increased as well. Seven pigs were born dead. Fifty-nine pigs were weaned, an average of 3.3 per litter. The low average for piglets weaned resulted in part from deaths caused by cardiac puncture and shock from loss of blood. The sex ratio was 40 males to 36 females farrowed. The sows had good maternal instinct and readily nursed the pigs. The growth of the piglets is shown in table 1.

TABLE 2.—*Some biochemical values in the whole-blood and serum components of 27 mature American-Essex pigs (male and female averages are combined)*

[Average of 189 samples]

Component		Value	Std. dev.
Cholinesterase (whole blood)	Δ pH	0.26	0.03
Copper	mg/100 ml	0.259	0.037
Creatinine	mg/100 ml	1.95	0.43
Glucose	mg/100 ml	90.5	17.0
Inorganic phosphorus	mg/100 ml	5.53	0.55
Iron	mg/100 ml	0.341	0.092
Magnesium	mg/100 ml	2.66	0.23
Potassium	mg/100 ml	17.40	2.13
Sodium	mg/100 ml	346.0	18.0
Total calcium	mg/100 ml	13.06	1.32
Total protein	g/100 ml	8.77	0.6
Urea nitrogen	mg/100 ml	15.14	2.8
Uric acid	mg/100 ml	0.23	0.065
Zinc	mg/100 ml	0.097	0.019

Table 2 shows the averages of 189 determinations of components of blood serum samples made over 7 months in 27 mature AE pigs. The values compare closely to the norms given by Dunne (*3*) and Spector (*8*) for commercial swine and are similar to values listed for miniature swine, except that Crookshank and Shaw (*2*) indicate somewhat higher phosphorus levels and lower copper levels in the miniature pig than in the AE pigs.

Table 3 shows hematological values for the AE pig. The values reported are within the accepted range for ordinary swine of this age, as reported by Dunne (*3*). For miniature Hormel swine, the values reported by Earl et al. (*4*) compare to some extent with those reported here but not in all instances, notably for partial thromboplastin time (33 versus 12.5 seconds for the AE pig), WBC (19,000 versus 12,492 per cubic centimeter for the AE pig), and the lymphocyte-to-neutrophil ratio (74:21 versus 48:40 percent for the AE pig).

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TABLE 3.—*Hematological values of 27 mature American-Essex pigs (male and female averages are combined)*

[Average of 189 samples]

Component		Value	Std. dev.
Leukocytes	per mm³×10³	12.5	1.1
Band neutrophils	pct	0.3	0.2
Basophils	pct	0.5	0.5
Eosinophils	pct	9.3	2.0
Lymphocytes	pct	47.6	11.7
Monocytes	pct	3.2	2.6
Segmented neutrophils	pct	39.7	9.8
Mean corpuscular hemoglobin (MCH)	pg	25.6	...
Mean corpuscular hemoglobin concentration (MCHC)	pct	35.2	...
Mean corpuscular volume (MCV)	μm³	67.9	...
Erythrocytes	per mm³×10⁶	6.4	0.5
Hematocrit	vol. pct	44.0	8.4
Hemoglobin	g pct	15.5	2.4
Partial thromboplastin time	s	12.5	1.3
Prothrombin time	s	10.5	1.2
Reticulocytes	pct of RBC	1.1	0.03
Sedimentation rate	mm/h	25.3	2.6

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